

Established over 100 years ago and part of the Centre for Materials Engineering Research (CRIM) as well as the MATERIAUX Institute, the Department of Metallurgy at UMONS boasts recognised expertise in all things metal-related: ferrous and non-ferrous alloys found in a wide range of sectors, from steelmaking to battery recycling using chemical technologies.



Prof. Fabienne Delaunois. © UMONS - Department of Metallurgy

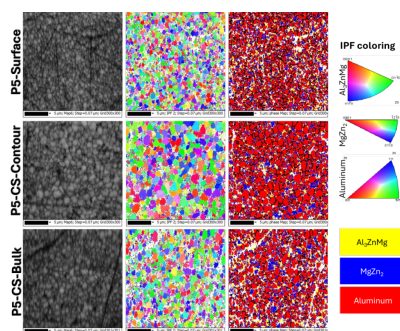


Prof. Véronique Vitry. © UMONS - Department of Metallurgy

The Metallurgy Department comprises around fifteen researchers, including two academics (Profs Fabienne Delaunois and Véronique Vitry), two technicians, three

postdoctoral researchers, ten PhD students (including one research assistant) and four students on joint supervision schemes with international universities. It currently has 15 ongoing projects.

Six research areas form the framework of the laboratory's activities. The first area has been its core expertise for over 35 years: wet surface treatment using electroless nickel plating. The second area concerns cemented carbide and powder metallurgy (notably the development of tungsten carbide tools). Third area: surface engineering, which covers coating, treatment and the characterisation of properties (wear resistance, corrosion resistance, etc.). Fourth area: additive manufacturing and post-processing to improve surface treatment. As for the fifth area, it encompasses processes (and their optimisation for example electrical steel production) as well as the recycling of batteries or magnesium-based refractories. Finally, the sixth, emerging area concerns archaeometallurgy in its two dimensions: archaeological reconstruction and archaeometry (characterisation of ancient metallic artefacts).



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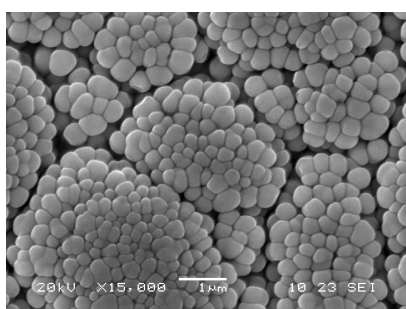
A patent for lead-free nickel-boron

The Metallurgy Department has capitalised on its expertise by filing a patent application for lead-free nickel-boron relating to autocatalytic nickel deposits. The innovation lies in the development of baths free from lead and thallium, which have been replaced by less toxic elements acting as stabilisers. Already granted in Luxembourg, the patent is currently under review at European level. Furthermore, the industrialisation of these baths is well underway at pilot scale, paving the way for a technology transfer that has already attracted the interest of several manufacturers.

Industrial collaborations

Manufacturers are at the very heart of the Metallurgy Department's research collaborations. The department is working in particular with Aperam (a company

producing and marketing stainless steel, electrical steel and special steels) and a Walloon SME on optimization of electric arc furnace processes, with funding from the Walloon Region. The same funding supports a collaboration with Technochim in Ghislenghien. The laboratory also works with the SME Diarotech, based in Charleroi, numerous research and technology centres (Centre Terre et Pierre – CTP in Tournai, Materia Nova, Sirris, Centre for Research in Metallurgy – CRM Group in Liège, Belgian Ceramic Research Centre – BCRC, CRITT Matériaux Innovation in Charleville-Mézières, etc.) as well as SCK•CEN in Mol (study of liquid lead corrosion for new nuclear reactors, in the wake of the MYRRHA project). Not to mention the ERDF and Interreg projects...



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International scientific collaborations

However, the Metallurgy Department's collaborations extend well beyond Europe's borders. Having worked for many years with Moroccan and Algerian partners in the context of cooperation and development, the laboratory is now collaborating with Burkina Faso on battery recycling, with funding from ARES. For the past decade or so, it has also been collaborating with Coventry University, which possesses highly complementary expertise in electrochemistry and wet surface treatment: a fourth joint PhD thesis is currently underway. The Université Polytechnique Hauts-de-France (Maubeuge and Valenciennes laboratories) is also among its research partners.

Failure analysis

More broadly, the Metallurgy Department offers its services to manufacturers through a 'failure analysis' approach. Equipment damage, parts returned by the customer, process anomalies, quality issues... These are all practical cases requiring in-depth analysis of the parts to identify the causes of deviations and improve design or manufacturing processes. However, this expertise does not stop at production: it also extends to disputes with customers (verification of the manufacturer's liability, forensic expert reports) and to collaborations with design offices in a consulting capacity. The launch of a spin-off is also under consideration to enhance these service offerings. Ultimately,

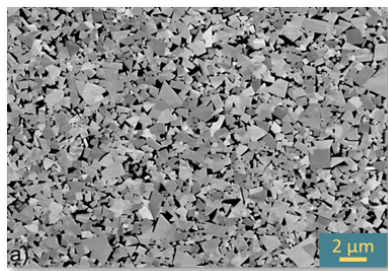
these case studies provide valuable learning material for engineering students and those enrolled on the ‘Fundamentals of Quality’ course at UMONS.



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Exciting research challenges

Drawing on its expertise, the Metallurgy Department is committed to continuing to make industrial processes sustainable and innovative. With this in mind, the first challenge to be tackled is undoubtedly the replacement of toxic or hazardous substances such as hexavalent chromium, cobalt, lead and thallium... but also metals that are difficult to obtain due to monopolies, extraction difficulties or rising demand. For instance, cobalt could eventually be replaced by iron-manganese alloys in cemented carbides. Similarly, zinc particles could replace platinum in the initial stages of surface treatment processes involving polymers or ceramics. The advantage is twofold, as this involves using a mechanism that is already known and economically viable.

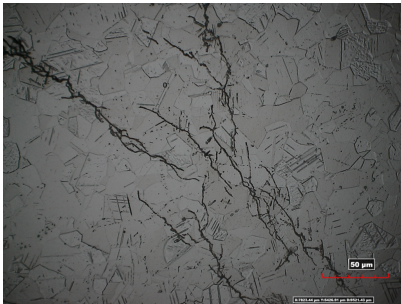


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Another challenge concerns the circularity of metals. This is the focus of the Opti-SurfAM project in collaboration with Technochim: the aim is to recover aluminium parts from end-of-life aircraft in order to remanufacture parts by an additive manufacturing process for other applications. The lab also works on separation and recycling of materials from batteries, with the aim to reduce cost, energy and materials use.

Whilst anticipating future technological breakthroughs in production processes, the Metallurgy Department also seeks to optimise existing processes (see the project with Aperam): sometimes, simply modifying certain equipment or parameters is enough to improve performance, reduce metal losses, increase yields and lower energy consumption – all of which are essential for a more sustainable steelmaking.

Ultimately, the aim is to supply more durable and higher-performing components upstream of the end-user. In other words, components that are less prone to wear and corrosion and which, as a result, should need replacing less often. Similarly, some manufacturers are seeking rollers with more durable characteristics. The result is less frequent upgrades. Because there are no small savings in industry: given its colossal volumes, every improvement, however minor, can have far-reaching consequences. The Metallurgy Department has clearly understood this!



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